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Abstract

PERFORMANCE AND OPERATION OF THE DOUNREAY FAST REACTOR

by

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1. The major engineering difficulties encountered during the commissioning stages of the reactor have been successfully overcome. The original metallic fuel concept has been retained and following redesign of the element as a result of experience on irradiation behaviour, the limiting burn-up of the fuel has been raised to over 1% of heavy atoms. The redesigned element permitted the reactor power to be raised to the design figure of 60 MW. The heat rejection plant has performed very satisfactorily, electrical power has been produced and exported to the National Grid.

2. Having demonstrated the feasibility of operating fast reactors at power, the reactor has now been converted into a valuable fast flux irradiation test facility capable of irradiating sub-assemblies, experimental fuel pins of varying lengths and specimens of canning materials.

3. Modifications to the reactor circuits have been made to increase the capacity of the cold trapping system and new in-line purity measuring devices have been successfully developed. Other additions have been a corrosion sampling device which is operable at full circuit pressure and a corrosion measuring device in one of the by-pass circuits. Certain other modifications have been made as required by experience with activity in the cover gas arising from the use of vented fuel elements.

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4. A description is given of the major steps in starting up and shutting down the reactor, together with an outline of the method of control.

5. Performance of plant components has been generally good, particularly the instrumentation and safety circuits. No unscheduled shut downs from power have been necessary, nor initiated by instrument failures.

6. The kinetic behaviour of the reactor has been extensively studied and generally is in agreement with prediction. The stability of the reactor has been established throughout the entire operating range, and results indicate that prompt positive coefficients have been successfully eliminated by the design adopted.

7. With the achievement of full power operation, experience has been rapidly gained on the control of the fission product activity both during normal operation and during maintenance operations. The chemistry of the coolant has been studied in so far as compatibility of the canning materials is concerned, and the results of reactor and loop experiments are compared.

8. Fabrication of the redesigned metallic fuel element has not given rise to any particular difficulty. Operational experience with the fuel element charge machines and improvements giving increased rates of handling elements are described.

9. The chemical reprocessing plant has now commenced operation with highly irradiated fuel and the mechanical removal of the can has given rise to several problems arising from the changed nature of the fuel and canning materials. Very satisfactory techniques and equipment have been evolved for the dissolution process and the fission product decontamination in the separation plant has been very efficient. The problem of solvent degradation has not been so severe as expected mainly because of the efficiency of the first wash process.